VIRGINIA DEPARTMENT OF TRANSPORTATION

TRAFFIC ENGINEERING DIVISION INSTRUCTIONAL & INFORMATIONAL MEMORANDUM

GENERAL SUBJECT: Traffic Signals		NUMBER: IIM-TE-381
		SUPERSEDES: None
SPECIFIC SUBJECT:		DATE: January 27, 2016
Flashing Yellow Arrow Signal Indication for Permissive Left-Turn Movements		SUNSET DATE: None
DIRECTED TO:	APPROVAL:	
Regional Operations Engineers/Directors Regional Traffic Engineers Regional Operations Maintenance Managers Regional Traffic Operations Managers State Location & Design Engineer District Transportation and Land Use Directors District Location & Design Engineers	/original signed by/ Raymond J. Khoury, P.E. State Traffic Engineer Richmond, VA Approved January 27, 2016	

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Attachment B - Complete Section - Virginia Supplement to the MUTCD, Revision 1, Section 2B.53

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Attachment E - Complete Section - Virginia Supplement to the MUTCD, Revision 1, Section 4D.20

EFFECTIVE DATE

<u>Future contracts</u>: This Memorandum shall be effective for all contracts with an advertisement on or after September 1, 2016.

<u>Existing contracts</u>: This Memorandum may be applied to signals constructed under existing contracts (including existing Regional Traffic Signal Construction Contracts) if the change is approved by the Project Engineer.

<u>Existing signals</u>: This Memorandum may be used to evaluate replacing existing signal indications with FYA signal heads. It is recommended that FYA be considered as a potential spot or corridor safety improvement.

<u>Land use permit for private developments</u>: This Memorandum shall be effective for all projects where the signal design has not yet been submitted to VDOT, and may also be applied to permit projects currently under VDOT review if feasible to do so. The permittee may request to apply this policy to a previously-approved permit if approved by the District's Land Use Permit Office and the Regional Traffic Engineer (RTE) or their designee.

<u>Design-Build or PPTA projects</u>: This Policy shall be effective for projects in which the design criteria package has not been completed for advertisement as of September 1, 2016. For current Design-Build or PPTA projects, this Policy should be implemented where practical and feasible.

PURPOSE AND NEED

The flashing yellow arrow (FYA) indication is an increasingly popular treatment for improving driver comprehension of traffic signals at locations with permissive left-turning movements. Additional benefits of FYA include increased operational flexibility and the potential for improved safety. FYA is also a tool that can be used along with proper phase sequencing to eliminate the "yellow trap". As such, when an exclusive left turn lane exists FYA is now VDOT's preferred method for signalizing protected/permissive left turns and FYA may be used for permissive-only left turns as well. This memorandum establishes a clear and consistent set of guidelines for the effective use of FYA on VDOT-maintained roadways.

In July 2011, VDOT issued a draft document "Guidelines for the use of Flashing Yellow Arrows for Permissive Left Turns." The document was never finalized or formally adopted, but was implemented in certain areas of the state. The 2011 document was based on the 2003 MUTCD and an FHWA Interim Approval, which are no longer in effect, with the 2009 MUTCD and 2011 Virginia Supplement to the MUTCD now governing the installation of traffic control devices. These new guidelines will replace the 2011 draft document, will address common misconceptions about the use of FYA, and promote uniform application.

The July 2011 draft "Guidelines for the use of Flashing Yellow Arrows for Permissive Left Turns" should no longer be used for implementation of FYA signal indications. The technical aspects outlined within Attachment A should be used instead.

RELATED CHANGES TO THE VIRGINIA SUPPLEMENT TO THE MUTCD

This memorandum makes the following changes to the 2011 Virginia Supplement to the MUTCD. Revision 1:

- Recommends FYA for all protected/permissive left turns when an exclusive left-turn lane exists.
- Adds an Option to utilize FYA for permissive only left-turn movements when an exclusive left-turn lane exists.
- Removes the recommendation for circular green indications for permissive only left-turn movements where exclusive left-turn lanes exist.
- Adds Option to use a four-section signal face for permissive only or protected-only left turns where there is a potential for future conversion to protected/permissive mode.
- Recommends the use of the LEFT TURN YIELD ON FLASHING YELLOW ARROW sign at all locations with FYA, and notes its importance at locations where changes to signal phasing are implemented.

These changes to the Supplement are shown below, and the complete Sections of the Supplement are provided as attachments to the memorandum.

These changes to the Supplement do not replace or duplicate the other Standards, Guidance, and Options found in the MUTCD that apply to signalization of left-turn movements. These sections of the Supplement must be considered in addition to the general requirements for traffic signal control features and left-turn movements in Chapter 4D of the MUTCD and the Supplement.

Section 2B.53 Traffic Signal Signs (R10-5 through R10-30)

Section 2B.53 of the Supplement is modified to:

- remove the reference to the R10-V1 sign in paragraph 02; and
- insert paragraphs 02a and 02b, immediately following paragraph 02 as shown below.

Option:

Traffic Signal signs (see Figure 2B-27(VA) in this Supplement) may be installed at certain locations to clarify signal control. Among the legends that may be used for this purpose are LEFT ON GREEN ARROW ONLY (R10-5), STOP HERE ON RED (R10-6 or R10-6a) for observance of stop lines, DO NOT BLOCK INTERSECTION (R10-7) for avoidance of traffic obstructions, USE LANE(S) WITH GREEN ARROW (R10-8) for obedience to lane-use control signals (see Chapter 4M), LEFT TURN YIELD ON GREEN (symbolic circular green) (R10-12), LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-V1), and LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27).

Guidance:

12a If a flashing left-turn YELLOW ARROW signal indication is used to control a left-turn movement operated in permissive only mode or protected/permissive mode, the LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-V1) sign should be used to clarify the signal control.

Support:

o2b If a flashing left-turn YELLOW ARROW signal indication is being implemented concurrent with changes to the signal phasing (e.g. converting from protected only to protected/permissive), the LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-V1) sign is especially important as it will draw attention to the new phasing.

Section 4D.18 <u>Signal Indications for Permissive Only Mode</u> Left-Turn Movements

Section 4D.18 of the Supplement is modified to:

- insert paragraphs 03a, 03b, and 03c immediately following paragraph 03;
- delete paragraphs 04 and 05; and
- delete the Virginia-specific note in Figure 4D-7(VA)

as shown below.

Option:

- osa If a left-turn movement is operated in a permissive only mode and an exclusive left-turn lane exists, a separate left-turn signal face displaying a flashing left-turn YELLOW ARROW signal indication may be used as described in Paragraph 3.
- O3b If a separate left-turn signal face for a permissive only mode left turn is provided and there is potential for future conversion to a protected/permissive mode left turn, the separate signal

face may contain provisions for four signal indications to accommodate a flashing left-turn YELLOW ARROW signal indication.

Standard:

- o3c If a separate left-turn signal face is provided for a permissive only mode left turn with future provisions for conversion to a protected/permissive mode left turn, it shall meet the following requirements (see Figure 4D-12):
 - A. It shall be capable of displaying the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, flashing left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the four indications shall be displayed at any given time.
 - B. During the permissive left-turn phase, a flashing left-turn YELLOW ARROW signal indication shall be displayed.
 - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn YELLOW ARROW signal indication.
 - D. When the left-turn movement is operated in permissive only mode, the left-turn GREEN ARROW signal indication shall not be displayed.

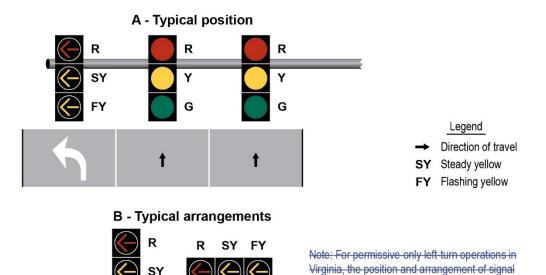
Guidance:

94 If a left-turn movement is operated in a permissive only mode at all times, a shared signal face with a steady CIRCULAR GREEN signal indications should be used instead of a separate left-turn signal face with a flashing YELLOW ARROW indication.

Support:

NCHRP studies are inconclusive regarding the benefits of flashing YELLOW ARROW for permissive only left-turn situations. In order to maintain uniformity, consistency, and driver expectations, the use of the flashing YELLOW ARROW at permissive only left-turns is discouraged in favor of the steady CIRCULAR GREEN indication. The flashing YELLOW ARROW can still be utilized at protected/permissive mode left-turns (see Section 4D.20 of the MUTCD).

Figure 4D-7(VA). Typical Position and Arrangements of Separate Signal Faces with Flashing Yellow Arrow for Permissive Only Mode Left Turns



faces should follow that shown in Figure 4D-6

Option: The separate left-turn signal face may contain provisions for four signal indications.

Section 4D.19 <u>Signal Indications for Protected Only Mode Left-</u> Turn Movements

Section 4D.19 of the Supplement is modified to add paragraphs 05 and 06 immediately following paragraph 04 as shown below.

Option:

If a separate left-turn signal face for a protected only mode left turn is provided and there is potential for future conversion to a protected/permissive mode left turn during some or all hours of the day, the separate signal face may contain provisions for four signal indications to accommodate a flashing left-turn YELLOW ARROW signal indication.

Standard:

- of If a separate left-turn signal face is provided for a protected only mode left turn with future provisions for conversion to a protected/permissive mode left turn, it shall meet the following requirements (see Figure 4D-12):
 - A. It shall be capable of displaying, the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, flashing left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the four indications shall be displayed at any given time.
 - B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.
 - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.
 - D. When the left-turn movement is operated in protected only mode, the flashing left-turn YELLOW ARROW signal indication shall not be displayed.

Section 4D.20 <u>Signal Indications for Protected/Permissive</u> <u>Mode Left-Turn Movements</u>

Section 4D.20 from the 2009 MUTCD (Revision 2), including Figures 4D-11 and 4D-12, are incorporated into the Supplement with paragraph 03a inserted between Paragraphs 03 and 04 as shown below.

Guidance:

A flashing left-turn YELLOW ARROW signal indication should be used for protected/permissive left-turns on VDOT-maintained roadways at locations where an exclusive left-turn lane exists, unless it is not feasible due to structural limitations, equipment compatibility, or similar reasons. Where it is not feasible to install a flashing YELLOW ARROW signal display as part of a signal modification based on an evaluation conducted per IIM-S&B-82, TED-357 because of structural limitations, the operational and/or safety benefits provided by the flashing YELLOW ARROW should be evaluated, and VDOT will determine if a new structure is justified.

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ATTACHMENT A

Flashing Yellow Arrow Signal Indication for Permissive Left-Turn Movements – Technical Aspects for Implementation

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BACKGROUND

In 2006, FHWA issued Interim Approval 10, which allowed transportation agencies to request permission to use the FYA indication. The Interim Approval was issued based upon the research conducted in NCHRP 493: Evaluation of Traffic Signal Displays for Protected/Permissive Left-Turn Control. In 2008 VDOT requested and was granted FHWA permission (IA-10.48) to use FYA on any public road in Virginia. FHWA issued Interim Approval 10 during the time that the 2003 MUTCD was in effect. With the adoption of the 2009 MUTCD and the Virginia Supplement, FHWA and VDOT incorporated FYA into these documents. Therefore, FHWA terminated the Interim Approval and it is no longer in effect.

Before the incorporation of FYA into the MUTCD and Virginia Supplement, Central Office-Traffic Engineering Division (CO-TED) distributed preliminary draft guidance on FYA for Permissive Left Turns, dated July 2011. That draft document provided the history of FYA, an overview of some left-turn phase selection, guidance for signing and public outreach, controller considerations, and inventory requirements. One key component of this guidance is:

"VDOT has not yet adopted the 2009 MUTCD; hence this document presents guidelines for implementing FYA for permissive turns in Virginia until VDOT adopts the 2009 MUTCD."

In December 2011, Virginia adopted both the 2009 MUTCD and the 2011 Virginia Supplement to the MUTCD, both of which include FYA. The preliminary draft guidance became obsolete at that time and has been superseded by content in other CO-TED products, national best practices, and other literature. Therefore, CO-TED is rescinding the July 2011 draft document "Guidelines for the use of Flashing Yellow Arrows for Permissive Left Turns" and it should no longer be used as guidance. This document supersedes the 2011 draft document and provides additional guidance and clarification beyond that found in the MUTCD and Virginia Supplement.

The guidelines in this document should be considered in addition to requirements contained in the MUTCD and other sections of the 2011 Virginia Supplement to the MUTCD, as this document does not replace or repeat all applicable requirements in the MUTCD.

LEFT-TURN PHASE SELECTION

Refer to VDOT's <u>Guidance for Determination and Documentation of Left-Turn Phasing Mode</u> for information on making decisions related to left-turn phasing mode selection.

MEANING OF THE FLASHING YELLOW ARROW INDICATION

FYA is an alternative method for displaying permissive left-turn operation to a driver. Prior to the introduction of FYA, the circular green indication was the only way to indicate a permissive left turn.

According to the <u>Code of Virginia § 46.2-833</u>, "Flashing amber arrow indicates that traffic may turn in the direction of such signal with reasonable care under the circumstances. Such traffic shall yield the right-of-way to pedestrian and vehicular traffic lawfully within the intersection."

The flashing amber arrow is equivalent to FYA according to Section 4D.04 of the Virginia Supplement.

BENEFITS OF THE FLASHING YELLOW ARROW

FYA offers several benefits and advantages over the traditional circular green indication for permissive left turns. These benefits include:

- Greater flexibility to implement different <u>phasing</u> during different time periods. FYA can allow the same movement at an intersection to function with protected only, permissive only, or protected/permissive phasing at different times of the day.
- The left-turn signal indication is not tied to the through movement indication with a shared head, which is the case with the five-section signal head. FYA can be displayed to left-turning vehicles with a separate signal head for left turns at the same time a circular red is displayed to adjacent through traffic. This is a helpful tool for eliminating the yellow trap, which will be discussed in greater detail later in this Attachment. With circular green indications for permissive left turns, it is not possible to display a circular red to through vehicles and a circular green to adjacent left-turning vehicles at the same time.
- Greater flexibility to safely implement different <u>sequencing</u> during different time periods. With a circular green signal display for permissive left turns, a yellow trap situation may be created if there are lagging left turns. The yellow trap situation can be eliminated by using FYA with proper phasing changes.
- FYA is more effective than the circular green indication for communicating that drivers must yield to oncoming traffic when turning left according to research conducted as part of NCHRP Report 493. It was this NCHRP research that led FHWA to include FYA in the 2009 MUTCD.

As a result of the greater flexibility, increased effectiveness, and potential safety benefits, FYA is the preferred method for signalizing protected/permissive left turns on VDOT-maintained roadways. FYA may also be used for permissive only left-turn applications.

YELLOW TRAP

The yellow trap is a safety concern for permissive left turns. It can occur when the signal display for the left-turn vehicle initiates the yellow change and red clearance intervals while at the same time opposing through vehicles are still receiving a circular green display. This practice is in violation of the Standard in Section 4D.05, Paragraph 3, Item B.4 of the MUTCD.

When the yellow trap occurs, drivers facing the clearing left-turn phase may incorrectly assume the opposite direction's through phase is also terminating and that the opposing traffic will be coming to a stop. The left-turn driver may attempt to complete the turn thinking opposing traffic is slowing or stopping and instead collide with vehicles in the opposing through traffic stream. This typically occurs when the opposing direction has a lagging protected left-turn phase (either protected only or as part of protected/permissive phasing). The result is a violation of driver expectancy, conflicts between left-turn vehicles and opposing through vehicles, and in the worst-case scenario, a crash. **Figure 1** illustrates one example of how a yellow trap occurs. In

the figure, the northbound left-turning vehicle driver assumes that the southbound through phase is terminating at the same time as the northbound through phase.

FYA can be used to eliminate the yellow trap. In order to eliminate the yellow trap with FYA, the operation must allow the permissive left-turn phase (FYA) to continue until the opposing traffic's through phase terminates, even if the adjacent through phase has already terminated. In this scenario, the left-turn traffic will see FYA while the adjacent through traffic will see a circular red, and the left-turning vehicles can continue waiting for a gap in the opposing through traffic before turning. The FYA permissive left-turn phase will not end until the opposing through traffic's phase ends. An example of how FYA can eliminate the yellow trap is shown in **Figure 2**. Within this example, the northbound permissive left-turn phase is extended until the termination of the southbound through phase.

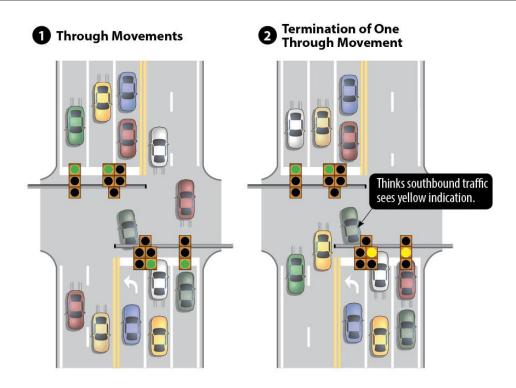
There is a common misconception that the yellow trap can be eliminated entirely by installing FYA signal indications. This is **only true if the FYA installation is accompanied by appropriate consideration of all possible sequencing combinations, including special patterns such as phase skips and emergency vehicle preemption.** It is still possible to have a yellow trap even with FYA if certain sequencing is allowed in the operation. It is incumbent upon the engineer to evaluate all phasing <u>and</u> sequencing possibilities permitted in the operation to ensure that the yellow trap cannot occur, as Section 4D.05, Paragraph 3 of the MUTCD prohibits the yellow trap except in rare and unusual cases.

If FYA terminates at the same time as the adjacent through phase while the opposing through traffic still has a circular green displayed, the yellow trap condition still exists. Even if this phase sequencing does not occur normally, the engineer should consider when some phases are skipped due to lack of demand or preemption. **Figure 3** shows an example of how the yellow trap can occur with FYA. In the figure, the traffic signal's typical operation includes a leading left-turn phase and a lagging left-turn phase, but the lagging left-turn and side street phases are skipped due to apparent lack of demand.

Therefore, when implementing FYA designers and engineers should review all potential sequencing combinations, including when phases are skipped due to lack of demand and special patterns such as preemption, to determine if a yellow trap situation could occur. If there is a possibility of a yellow trap, modifications to sequencing and controller programming parameters should be incorporated into design as necessary to eliminate the yellow trap. Primary responsibility lies with the design engineer to include adequate information in design plans for others who may be establishing sequences and controller programming.

VDOT's traffic signal engineering maintenance and engineering operations staff are available to assist with the evaluation of potential yellow trap situations at specific locations, although the primary responsibility for this evaluation lies with the designer. Additional resources with information about traffic signal timing to avoid the yellow trap can be found in the MUTCD, FHWA's MUTCD Frequently Asked Questions, and the Minnesota DOT's Traffic Signal Timing and Coordination Manual.

Figure 1 - Left Turn Trap



3 Left Turn Trap

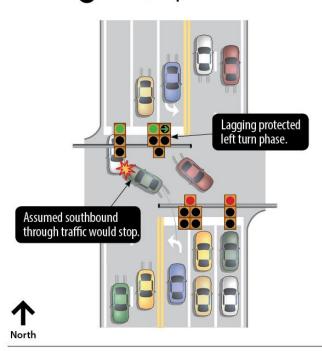
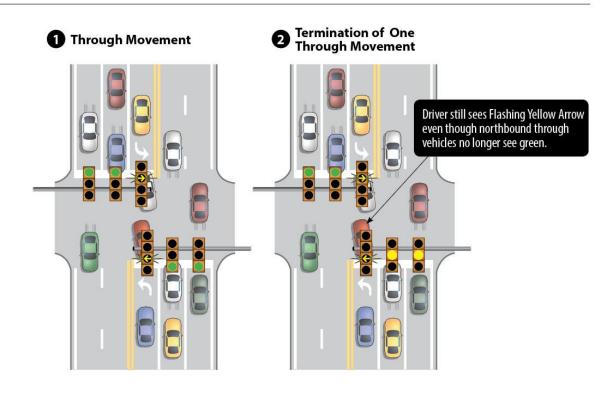




Figure 2 - Elimination of Left Turn Trap with Flashing Yellow Arrow



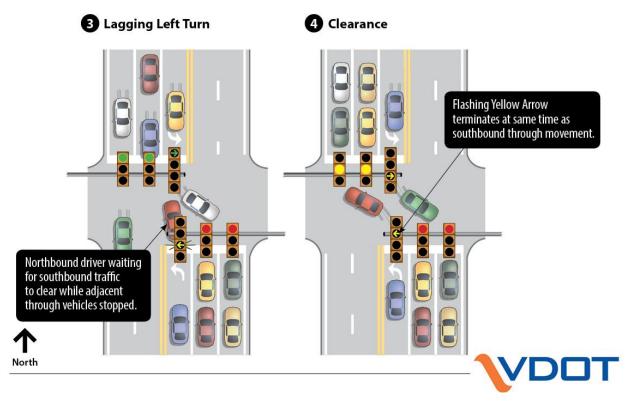
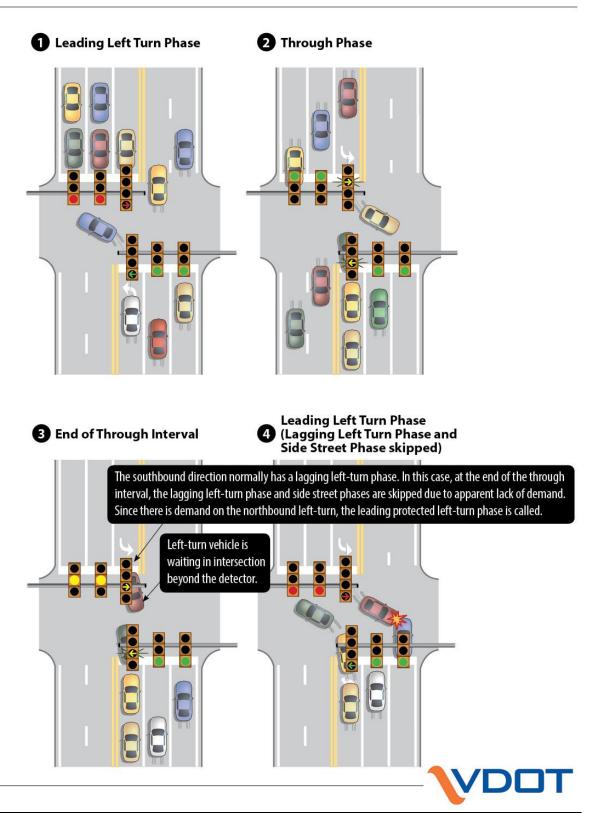


Figure 3 - Left-Turn Trap with Flashing Yellow Arrow



North

CHANGE AND CLEARANCE INTERVALS

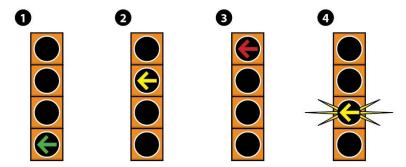
When FYA is used and the permissive phase immediately follows the protected phase, there are two methods that can be used to transition from the protected phase to a permissive phase, hereinafter referred to as Type 1 and Type 2.

A **Type 1 Transition** contains an all-red clearance interval between the protected and permissive left-turn phases, with successive displays as follows:

- 1. Protected left-turn phase green arrow displayed
- 2. Change interval steady yellow arrow displayed
- 3. All-red clearance interval steady red arrow displayed
- 4. Permissive left-turn phase flashing yellow arrow displayed, left-turning vehicles must yield to oncoming traffic.

A Type 1 transition is shown in **Figure 4**.

Figure 4 - Type 1 Transition

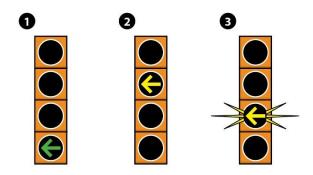


A **Type 2 Transition** does not include an all-red clearance interval between the protected and permissive left-turn phases as follows:

- 1. Protected left-turn phase green arrow displayed
- 2. Change interval steady yellow arrow displayed
- 3. Permissive left-turn phase flashing yellow arrow displayed, left-turning vehicles must yield to oncoming traffic

A Type 2 transition is shown in **Figure 5**.

Figure 5 - Type 2 Transition



The MUTCD and Virginia Supplement do not specify whether Type 1 or Type 2 transitions should be used when shifting from protected phases to permissive phases. A state-of the practice review indicated that approximately 70% of responding states that use FYA use Type 1 transitions. The rationale for this is a perceived safety benefit. The other perspective is that the Type 2 series of signal displays is analogous to what is currently employed for five-section protected-permissive signal heads and also provides more efficient intersection operation. There is no formal Federal guidance on whether a Type 1 or Type 2 transition is more appropriate. NCHRP will be initiating a research study in the coming year and until that time, both types of operation may be used for VDOT maintained roadways.

Type 1 transitions should be used at all locations where a permissive phase does not always follow the protected phase, especially when the sequence of the protected phase switches between leading and lagging throughout the day. This is to ensure that drivers do not enter the intersection during the change interval assuming that a permissive phase will immediately follow the change interval when there is no permissive phase at certain times of the day. At all other locations, engineering judgment should be used to determine whether a Type 1 or Type 2 transition is most appropriate for a given location.

For both Type 1 and Type 2 transitions, the length of the yellow change interval and the all-red clearance interval (Type 1 only) should be calculated according to the most recent edition of <u>TE-306</u>.

SUPPLEMENTAL SIGNING FOR FLASHING YELLOW ARROW

Prior to the changes made through this memorandum, Section 2B.53 of Revision 1 of the Virginia Supplement allowed optional use of the LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-V1) sign (see Figure 6) to clarify the meaning of FYA. As part of this memorandum, the Supplement is changed to recommend the use of this sign at all locations where FYA is used.

FHWA's MUTCD Frequently Asked Questions indicates the MUTCD does not include a standard sign for FYA because national research found that the FYA display is intuitively obvious in meaning to drivers and that an explanatory sign was unnecessary. VDOT has determined

Figure 6 - R10-V1



that there may be benefit in providing such a sign and has therefore included the R10-V1 sign in the Virginia Supplement. When used on new installations, the sign design should match the design shown in the Virginia Supplement and the <u>Virginia Standard Highway Signs</u> book, and the sign should be located adjacent to the FYA signal face.

If FYA is being implemented concurrent with changes to the signal phasing (e.g. converting from protected only to protected/permissive), the use of the sign is especially important, as it will draw attention to the new phasing.

TRAFFIC SIGNAL HEAD TYPE SELECTION

A separate signal face capable of displaying FYA <u>should</u> be used at all locations with an exclusive left-turn lane where protected/permissive left turns are determined to be appropriate.

A separate signal face capable of displaying FYA <u>may</u> be used at all locations with an exclusive left-turn lane where permissive only left turns are determined to be appropriate.

A signal face with FYA <u>should not</u> be used facing a shared left-turn/through lane, regardless of the left-turn phasing mode, except for approaches with no through movement as detailed in Section 4D.25 of the MUTCD.

In order to support the eventual full deployment of FYA at appropriate signalized locations, any signal modifications, replacements, or new installations should incorporate FYA where applicable. The FYA should be installed even if other similar protected/permissive mode displays along the corridor use a circular green indication for the permissive phase. Over time as signals are upgraded, the remaining circular green indications will be phased out and signals will consistently use FYA for protected/permissive phasing.

The Virginia Supplement Section 4D.18 (Signal Indications for Permissive Only Mode Left-Turn Movements) formerly included support statements discouraging the use of FYA for permissive only left turns. These statements were based on past NCHRP studies and were also included to discourage unnecessary traffic signal modifications solely to implement FYA for permissive-only left turns. Section 4D.18 of the Virginia Supplement is hereby modified in this I&IM to remove those statements.

Future Considerations

When choosing the signal head type for a left-turn phase, consideration should be given to future conditions. A four-section FYA signal head may be considered at locations where protected-only (or permissive-only) left-turn phasing has been selected, but where there may be future potential to provide permissive mode (or protected mode) left turns as traffic conditions change, such as through variable mode/time-of-day phasing changes. While one section of the signal face will initially remain unused, this will reduce future equipment installations and signal modifications if protected/permissive phasing is implemented.

At locations where permissive or protected left-turn phasing would not foreseeably be used, three-section signal faces would still be appropriate.

Three-Section FYA Signal Displays

When considering use of a three-section FYA signal face on VDOT-maintained roadways per FHWA Interim Approval 17, proper operation and monitoring should be validated through bench testing or other accepted process with the specific controller and associated equipment that is to be used in the field. VDOT has been notified that some signal controllers and associated equipment may not be capable of accommodating the three-section FYA signal face operation per IA-17.

VDOT's approval of three-section FYA signal faces under IA-17 only applies to VDOT-maintained roadways. In order to use three-section FYA signal faces on other roadways, a separate approval from FHWA is required for the specific transportation agency.

EQUIPMENT COMPATIBILITY

As with implementation of any intersection control strategies, before implementing FYA the capabilities of the traffic signal controller unit and associated equipment (load switches, conflict monitors / malfunction management units, bus interface units, etc.) should be reviewed, tested, and validated to ensure proper operation and monitoring in all possible phase sequence, preemption, and other display capabilities. Upcoming modifications to statewide controller specifications include requirements to comply with NEMA's FYA addendum (for NEMA controllers) or utilize the most recently VDOT approved software (for 2070 controllers) which includes FYA programming.

FLASHING OPERATION DURING SIGNAL MALFUNCTION

MUTCD Standards provide flexibility for the FYA signal face to flash either a red arrow or yellow arrow during flashing operation. Typically when the FYA signal face is used, left turns that operate under permissive-only or protected-permissive phasing should flash a yellow arrow and left turns that operate with protected-only phasing should flash a red arrow during flashing operation. This is consistent with the historical malfunction flash patterns used by VDOT.

There may be circumstances and situations where it is determined, based on engineering judgment, to utilize a different arrow indication during a malfunction than those described above. In those circumstances, the engineer should document the rationale behind the decisions on which arrow to flash. When variable mode phasing for left turns is used, engineering judgment should be used to select the appropriate color arrow to flash, and this decision should be appropriately documented.

PUBLIC OUTREACH

When FYA signal indications are first introduced in an area, it may be appropriate to engage in public outreach to inform road users, local law enforcement, and elected officials of the flashing yellow arrow. CO-TED and various VDOT Regions have developed press releases, other outreach information, and other strategies to inform the public of FYA. Common elements of these public outreach initiatives include: discussions on why FYA is being used, the meaning of FYA, and specifics on road user action(s) when traveling through an intersection with FYA. Contact CO-TED for copies of existing materials or support in public outreach.

INVENTORY OF LOCATIONS

As the use of FYA is now included in the 2009 MUTCD, the formal requirement for VDOT to maintain an inventory of locations per the Interim Approval is no longer in effect. However, VDOT is still maintaining a centralized list of FYA locations throughout Virginia for the purpose of sharing that information with the public through marketing and outreach efforts, as well as for research purposes. Regions shall notify Central Office upon activation of intersections with FYA so that this centralized listing can be updated and properly maintained. VDOT Regional staff should continue to maintain an inventory to use in response to media inquiries, for statewide reporting, safety analysis, and other maintenance purposes.

CONCLUSION

In implementing these guidelines, VDOT's traffic signal program is available to assist designers from outside the agency in making decisions related to the applicability of FYA indications, particularly related to equipment compatibility and special sequencing inquiries.

ATTACHMENT B

Complete Section

Virginia Supplement to the MUTCD, Revision 1, Section 2B.53

Section 2B.53 Traffic Signal Signs (R10-5 through R10-30)

Option:

- To supplement traffic signal control, Traffic Signal signs R10-5 through R10-30 may be used to regulate road users.
- Traffic Signal signs (see Figure 2B-27(VA) in this Supplement) may be installed at certain locations to clarify signal control. Among the legends that may be used for this purpose are LEFT ON GREEN ARROW ONLY (R10-5), STOP HERE ON RED (R10-6 or R10-6a) for observance of stop lines, DO NOT BLOCK INTERSECTION (R10-7) for avoidance of traffic obstructions, USE LANE(S) WITH GREEN ARROW (R10-8) for obedience to lane-use control signals (see Chapter 4M), LEFT TURN YIELD ON GREEN (symbolic circular green) (R10-12), and LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27).

Guidance:

102a If a flashing left-turn YELLOW ARROW signal indication is used to control a left-turn movement operated in permissive only mode or protected/permissive mode, the LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-V1) sign should be used to clarify the signal control.

Support:

o2b If a flashing left-turn YELLOW ARROW signal indication is being implemented concurrent with changes to the signal phasing (e.g. converting from protected only to protected/permissive), the LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-V1) sign is especially important as it will draw attention to the new phasing.

Guidance:

If used, the LEFT ON GREEN ARROW ONLY (R10-5) sign, the LEFT TURN YIELD ON GREEN (symbolic circular green) (R10-12) sign, the LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-V1) sign, or the LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign should be located adjacent to the left-turn signal face.

Option:

If needed for additional emphasis, an additional LEFT TURN YIELD ON GREEN (symbolic circular green) (R10-12) sign or LEFT TURN YIELD ON FLASHING YELLOW ARROW (R10-V1) sign with an AT SIGNAL (R10-31P) supplemental plaque (see Figure 2B-27(VA) in this Supplement) may be installed in advance of the intersection.

Option:

In situations where traffic control signals are coordinated for progressive timing, the Traffic Signal Speed (I1-1) sign may be used (see Section 2H.03 of the MUTCD).



Standard:

- The CROSSWALK STOP ON RED (symbolic circular red) (R10-23) sign (see Figure 2B-27(VA) in this Supplement) shall only be used in conjunction with pedestrian hybrid beacons (see Section 4F.02 of the MUTCD).
- The EMERGENCY SIGNAL (R10-13) sign (see Figure 2B-27(VA) in this Supplement) shall be used in conjunction with emergency-vehicle traffic control signals (see Section 4G.02 of the MUTCD).
- The EMERGENCY SIGNAL—STOP ON FLASHING RED (R10-14 or R10-14a) sign (see Figure 2B-27(VA) in this Supplement) shall be used in conjunction with emergency-vehicle hybrid beacons (see Section 4G.04 of the MUTCD).

Option:

In order to remind drivers who are making turns to yield to pedestrians, a Turning Vehicles Yield to Pedestrians (R10-15) sign (see Figure 2B-27(VA) in this Supplement) may be used.

Standard:

- 10 If used, the TURNING VEHICLES YIELD TO PEDESTRIANS (R10-15) sign shall utilize a fluorescent yellow-green background (see Figure 2B-27(VA) in this Supplement).
- A U-TURN YIELD TO RIGHT TURN (R10-16) sign (see Figure 2B-27(VA) in this Supplement) may be installed near the left-turn signal face if U-turns are allowed on a protected left-turn movement on an approach from which a right-turn GREEN ARROW signal indication is simultaneously being displayed to drivers making a right turn from the conflicting approach to their left.



Figure 2B-26. Pedestrian Signs and Plaques (Sheet 1 of 2)



Figure 2B-26. Pedestrian Signs and Plaques (Sheet 2 of 2)







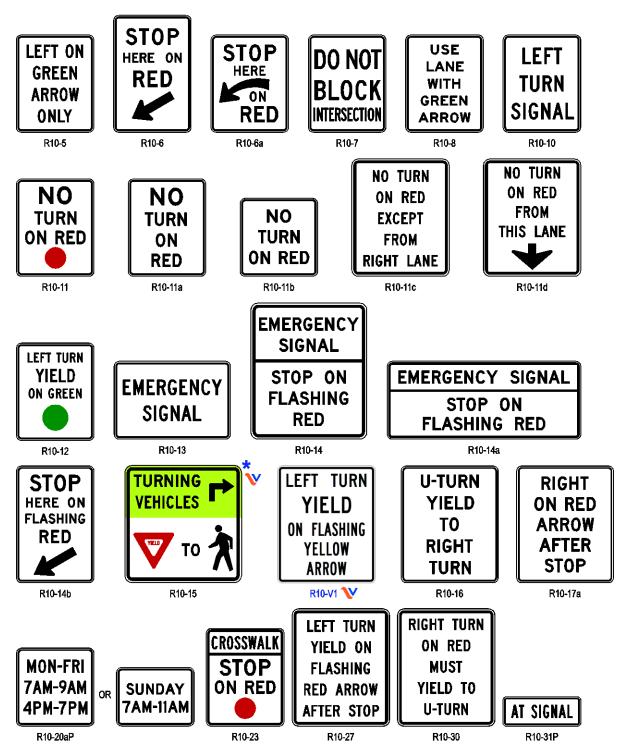


R10-4

R10-25

R10-32P

Figure 2B-27(VA). Traffic Signal Signs and Plaques



* A fluorescent yellow-green background color may shall be used instead of yellow for this sign. V

ATTACHMENT C

Complete Section

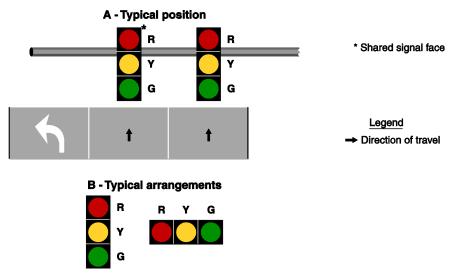
Virginia Supplement to the MUTCD, Revision 1, Section 4D.18

Section 4D.18 <u>Signal Indications for Permissive Only Mode</u> <u>Left-Turn Movements</u>

Standard:

- of If a shared signal face is provided for a permissive only mode left turn, it shall meet the following requirements (see Figure 4D-6):
 - A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, and CIRCULAR GREEN. Only one of the three indications shall be displayed at any given time.
 - B. During the permissive left-turn movement, a CIRCULAR GREEN signal indication shall be displayed.
 - C. A permissive only shared signal face, regardless of where it is positioned and regardless of how many adjacent through signal faces are provided, shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.
 - D. If the permissive only mode is not the only left-turn mode used for the approach, the signal face shall be the same shared signal face that is used for the protected/permissive mode (see Section 4D.20 of the MUTCD) except that the left-turn GREEN ARROW and left-turn YELLOW ARROW signal indications shall not be displayed when operating in the permissive only mode.
- If a separate left-turn signal face is being operated in a permissive only left-turns mode, a CIRCULAR GREEN signal indication shall not be used in that face.

Figure 4D-6. Typical Position and Arrangements of Shared Signal Faces for Permissive Only Mode Left Turns



- o3 If a separate left-turn signal face is being operated in a permissive only left-turn mode and a flashing left-turn YELLOW ARROW signal indication is provided, it shall meet the following requirements (see Figure 4D-7(VA) in this Supplement):
 - A. It shall be capable of displaying the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, and flashing left-turn YELLOW ARROW. Only one of the three indications shall be displayed at any given time.
 - B. During the permissive left-turn movement, a flashing left-turn YELLOW ARROW signal indication shall be displayed.
 - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn YELLOW ARROW signal indication.
 - D. It shall be permitted to display a flashing left-turn YELLOW ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.
 - E. During steady mode (stop-and-go) operation, the signal section that displays the steady left-turn YELLOW ARROW signal indication during change intervals shall not be used to display the flashing left-turn YELLOW ARROW signal indication for permissive left turns.
 - F. During flashing mode operation (see Section 4D.30 of the MUTCD), the display of a flashing left-turn YELLOW ARROW signal indication shall be only from the signal section that displays a steady left-turn YELLOW ARROW signal indication during steady mode (stop-and-go) operation.
 - G. If the permissive only mode is not the only left-turn mode used for the approach, the signal face shall be the same separate left-turn signal face with a flashing YELLOW ARROW signal indication that is used for the protected/permissive mode (see Section 4D.20 of the MUTCD) except that the left-turn GREEN ARROW signal indication shall not be displayed when operating in the permissive only mode.

Option:



- O3a If a left-turn movement is operated in a permissive only mode and an exclusive left-turn lane exists, a separate left-turn signal face displaying a flashing left-turn YELLOW ARROW signal indication may be used as described in Paragraph 3.
- 13b If a separate left-turn signal face for a permissive only mode left turn is provided and there is potential for future conversion to a protected/permissive mode left turn, the separate signal face may contain provisions for four signal indications to accommodate a flashing left-turn YELLOW ARROW signal indication.

Standard:

- 03c If a separate left-turn signal face is provided for a permissive only mode left turn with future provisions for conversion to a protected/permissive mode left turn, it shall meet the following requirements (see Figure 4D-12):
 - A. It shall be capable of displaying the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, flashing left-turn YELLOW ARROW, and left-

turn GREEN ARROW. Only one of the four indications shall be displayed at any given time.

- B. During the permissive left-turn phase, a flashing left-turn YELLOW ARROW signal indication shall be displayed.
- C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn YELLOW ARROW signal indication.
- D. When the left-turn movement is operated in permissive only mode, the left-turn GREEN ARROW signal indication shall not be displayed.

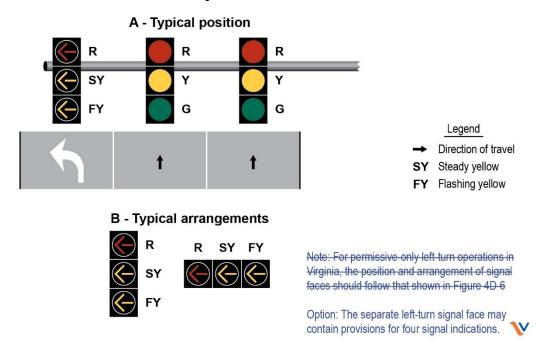
Option:

4 separate left-turn signal face with a flashing left-turn RED ARROW signal indication during the permissive left-turn movement may be used for unusual geometric conditions, such as wide medians with offset left-turn lanes, but only when an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive left turn.

Standard:

- e705 If a separate left-turn signal face is being operated in a permissive only left-turn mode and a flashing left-turn RED ARROW signal indication is provided, it shall meet the following requirements (see Figure 4D-8):
 - A. It shall be capable of displaying the following signal indications: steady or flashing left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. The GREEN ARROW indication is required in order to provide a three-section signal face, but shall not be displayed during the permissive only mode.
 - B. During the permissive left-turn movement, a flashing left-turn RED ARROW signal indication shall be displayed, thus indicating that each and every vehicle must successively come to a full stop before making a permissive left turn.
 - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn RED ARROW signal indication.
 - D. It shall be permitted to display a flashing left-turn RED ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.
 - E. A supplementary sign shall not be required. If used, it shall be a LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27(VA) in this Supplement).

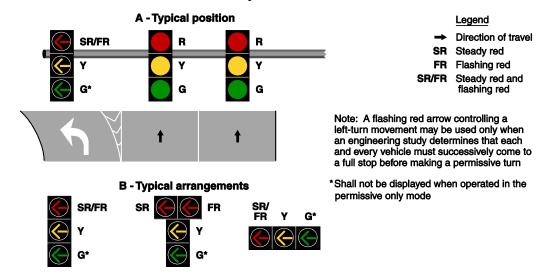
Figure 4D-7(VA). Typical Position and Arrangements of Separate Signal Faces with Flashing Yellow Arrow for Permissive Only Mode Left Turns



Option:

OBOO The requirements of Item A in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two left-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-8).

Figure 4D-8. Typical Position and Arrangements of Separate Signal Faces with Flashing Red Arrow for Permissive Only Mode and Protected/Permissive Mode Left Turns



ATTACHMENT D

Complete Section

Virginia Supplement to the MUTCD, Revision 1, Section 4D.19

Section 4D.19 <u>Signal Indications for Protected Only Mode Left-</u> Turn Movements

Standard:

- A shared signal face shall not be used for protected only mode left turns unless the CIRCULAR GREEN and left-turn GREEN ARROW signal indications always begin and terminate together. If a shared signal face is provided for a protected only mode left turn, it shall meet the following requirements (see Figure 4D-9):
 - A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, CIRCULAR GREEN, and left-turn GREEN ARROW. Only one of the three colors shall be displayed at any given time.
 - B. During the protected left-turn movement, the shared signal face shall simultaneously display both a CIRCULAR GREEN signal indication and a left-turn GREEN ARROW signal indication.
 - C. The shared signal face shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.
 - D. If the protected only mode is not the only left-turn mode used for the approach, the signal face shall be the same shared signal face that is used for the protected/permissive mode (see Section 4D.20 of the MUTCD).

Option:

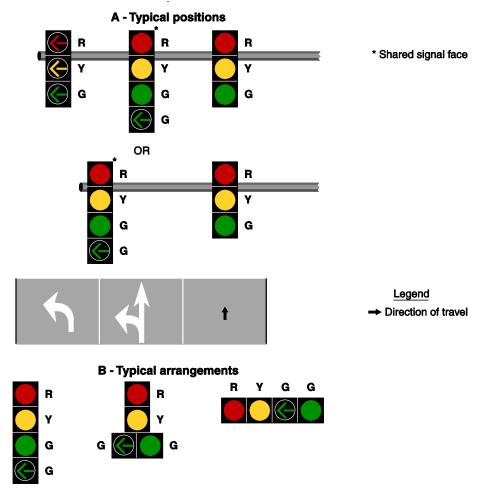
A straight-through GREEN ARROW signal indication may be used instead of the CIRCULAR GREEN signal indication in Items A and B in Paragraph 1 on an approach where right turns are prohibited and a straight-through GREEN ARROW signal indication is also used instead of a CIRCULAR GREEN signal indication in the other signal face(s) for through traffic.

Standard:

- If a separate left-turn signal face is provided for a protected only mode left turn, it shall meet the following requirements (see Figure 4D-10):
 - A. It shall be capable of displaying, the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. A signal instruction sign shall not be required with this set of signal indications. If used, it shall be a LEFT ON GREEN ARROW ONLY (R10-5) sign (see Figure 2B-27(VA) in this Supplement).
 - B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.
 - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.

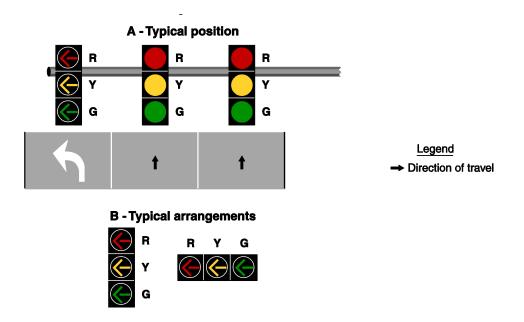
D. If the protected only mode is not the only left-turn mode used for the approach, the signal face shall be the same separate left-turn signal face that is used for the protected/permissive mode (see Section 4D.20 of the MUTCD and Figures 4D-8 and 4D-12) except that the flashing left-turn YELLOW ARROW or flashing left-turn RED ARROW signal indication shall not be displayed when operating in the protected only mode.

Figure 4D-9 Typical Positions and Arrangements of Shared Signal Faces for Protected Only Mode Left Turns



Note: Shared signal faces shall only be used for a protected-only mode left turn if the circular green and green left-turn arrow indications always begin and terminate together

Figure 4D-10 Typical Position and Arrangements of Separate Signal Faces for Protected Only Mode Left Turns





Guidance:

The LEFT ON GREEN ARROW ONLY sign (R10-5) should be used only after engineering judgment reveals a problem that could be mitigated by the sign.

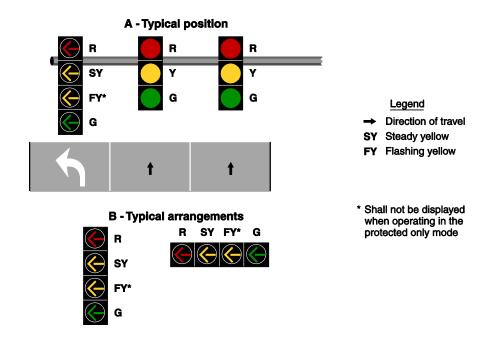
Option:

of If a separate left-turn signal face for a protected only mode left turn is provided and there is potential for future conversion to a protected/permissive mode left turn during some or all hours of the day, the separate signal face may contain provisions for four signal indications to accommodate a flashing left-turn YELLOW ARROW signal indication.

Standard:

- of If a separate left-turn signal face is provided for a protected only mode left turn with future provisions for conversion to a protected/permissive mode left turn, it shall meet the following requirements (see Figure 4D-12):
 - A. It shall be capable of displaying, the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, flashing left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the four indications shall be displayed at any given time.
 - B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.
 - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.
 - D. When the left-turn movement is operated in protected only mode, the flashing left-turn YELLOW ARROW signal indication shall not be displayed.

Figure 4D-12. Typical Position and Arrangements of Separate Signal Faces with Flashing Yellow for Protected/Permissive Mode and Protected Only Mode Left Turns



ATTACHMENT E

Complete Section

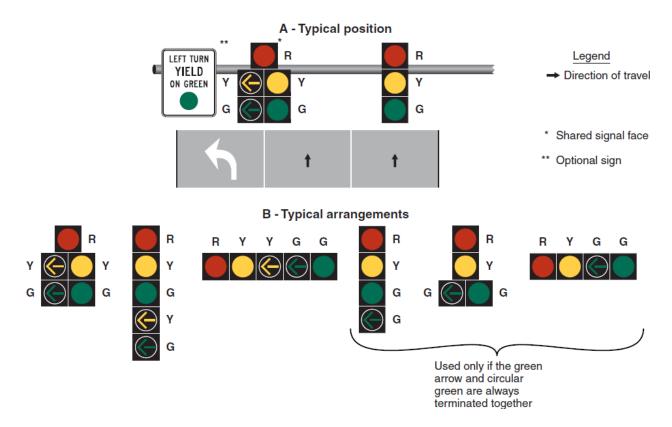
Virginia Supplement to the MUTCD, Revision 1, Section 4D.20

Section 4D.20 <u>Signal Indications for Protected/Permissive</u> <u>Mode Left-Turn Movements</u>

Standard:

- 11 If a shared signal face is provided for a protected/permissive mode left turn, it shall meet the following requirements (see Figure 4D-11):
 - A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, CIRCULAR green, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three circular indications shall be displayed at any given time. Only one of the two arrow indications shall be displayed at any given time. If the left-turn GREEN ARROW signal indication and the CIRCULAR GREEN signal indication(s) for the adjacent through movement are always terminated together, the steady left-turn YELLOW ARROW signal indication shall not be required.
 - B. During the protected left-turn movement, the shared signal face shall simultaneously display a left-turn GREEN ARROW signal indication and a circular signal indication that is the same color as the signal indication for the adjacent through lane on the same approach as the protected left turn.
 - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication, unless the left-turn GREEN ARROW signal indication and the CIRCULAR GREEN signal indication(s) for the adjacent through movement are being terminated together. When the left-turn GREEN ARROW and CIRCULAR GREEN signal indications are being terminated together, the required display following the left-turn GREEN ARROW signal indication shall be either the display of a CIRCULAR YELLOW signal indication alone or the simultaneous display of the CIRCULAR YELLOW and left-turn YELLOW ARROW signal indications.
 - D. During the permissive left-turn movement, the shared signal face shall display only a CIRCULAR GREEN signal indication.
 - E. A protected/permissive shared signal face, regardless of where it is positioned and regardless of how many adjacent through signal faces are provided, shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.
 - F. A supplementary sign shall not be required. If used, it shall be a LEFT TURN YIELD ON GREEN (symbolic circular green) (R10-12) sign (see Figure 2B-27(VA) in this Supplement).

Figure 4D-11. Typical Position and Arrangements of Shared Signal Faces for Protected/Permissive Mode Left Turns



- 11 If a separate left-turn signal face is being operated in a protected/permissive left-turn mode, a CIRCULAR GREEN signal indication shall not be used in that face.
- o3 If a separate left-turn signal face is being operated in a protected/permissive left-turn mode and a flashing left-turn yellow arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-12):
 - A. It shall be capable of displaying the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, flashing left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the four indications shall be displayed at any given time.
 - B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.
 - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.
 - D. During the permissive left-turn movement, a flashing left-turn YELLOW ARROW signal indication shall be displayed.
 - E. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn YELLOW ARROW signal indication if the permissive left-turn

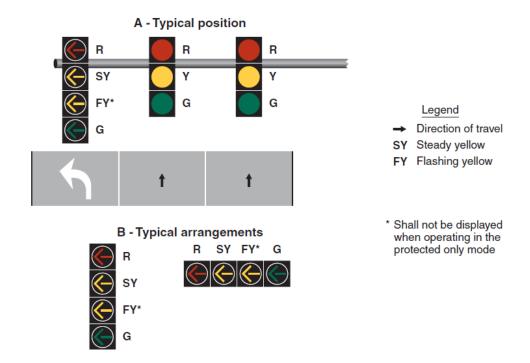
- movement is being terminated and the separate left-turn signal face will subsequently display a steady left-turn RED ARROW indication.
- F. It shall be permitted to display a flashing left-turn YELLOW ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.
- G. When a permissive left-turn movement is changing to a protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed immediately upon the termination of the flashing left-turn YELLOW ARROW signal indication. A steady left-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing left-turn YELLOW ARROW signal indication and the display of the steady left-turn GREEN ARROW signal indication.
- H. The display shall be a four-section signal face except that a three-section signal face containing a dual-arrow signal section shall be permitted where signal head height limitations (or lateral positioning limitations for a horizontally-mounted signal face) will not permit the use of a four-section signal face. The dual-arrow signal section, where used, shall display a GREEN ARROW for the protected left-turn movement and a flashing YELLOW ARROW for the permissive left-turn movement.
- During steady mode (stop-and-go) operation, the signal section that displays the steady left-turn YELLOW ARROW signal indication during change intervals shall not be used to display the flashing left-turn YELLOW ARROW signal indication for permissive left turns.
- J. During flashing mode operation (see Section 4D.30 of the MUTCD), the display of a flashing left-turn YELLOW ARROW signal indication shall be only from the signal section that displays a steady left-turn YELLOW ARROW signal indication during steady mode (stop-and-go) operation.

Guidance:



A flashing left-turn YELLOW ARROW signal indication should be used for protected/permissive left-turns on VDOT-maintained roadways at locations where an exclusive left-turn lane exists, unless it is not feasible due to structural limitations, equipment compatibility, or similar reasons. Where it is not feasible to install a flashing YELLOW ARROW signal display as part of a signal modification based on an evaluation conducted per IIM-S&B-82, TED-357 because of structural limitations, the operational and/or safety benefits provided by the flashing YELLOW ARROW should be evaluated, and VDOT will determine if a new structure is justified.

Figure 4D-12. Typical Position and Arrangements of Separate Signal Faces with Flashing Yellow for Protected/Permissive Mode and Protected Only Mode Left Turns



Option:

A separate left-turn signal face with a flashing left-turn RED ARROW signal indication during the permissive left-turn movement may be used for unusual geometric conditions, such as wide medians with offset left-turn lanes, but only when an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive left turn.

Standard:

- If a separate left-turn signal face is being operated in a protected/permissive left-turn mode and a flashing left-turn RED arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-8):
 - A. It shall be capable of displaying the following signal indications: steady or flashing left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time.
 - B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.
 - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.
 - D. During the permissive left-turn movement, a flashing left-turn RED ARROW signal indication shall be displayed.

- E. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn RED ARROW signal indication if the permissive left-turn movement is being terminated and the separate left-turn signal face will subsequently display a steady left-turn RED ARROW indication.
- F. When a permissive left-turn movement is changing to a protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed immediately upon the termination of the flashing left-turn RED ARROW signal indication. A steady left-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing left-turn RED ARROW signal indication and the display of the steady left-turn GREEN ARROW signal indication.
- G. It shall be permitted to display a flashing left-turn RED ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.
- H. A supplementary sign shall not be required. If used, it shall be a LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27(VA) in this Supplement).

Option:

The requirements of Item A in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two left-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-8).